Journal of Agrometeorology 5 (2) : 82 - 86 (Dec 2003)

Rainy season and its variability for crop planning in Udaipur region

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ABSTRACT

Rainy season and its variability in Udaipur region have been studied for the period 1981-2000. Start, end and length of rainy season were worked out by forward and backward accumulation method. The study reveals that off-season tillage and primary tillage may be started from 24th week and sowing of crop from 26th week. Occurrences of two consecutive dry weeks have been worked out by Markov-Chain model. Mid season drought is likely in 31st - 34th week and terminal drought in the 35th week in the region.

Key Words: Markov-Chain model, Probability analysis

Rainfall is the limiting factor for crop production in rainfed areas. The development of improved crop production technology in rainfed areas to increase food production requires quantitative understanding of the time and spatial variation of rainfall. Weekly rainfall data are very helpful for determining (i) date of start (ii) date of cessation (iii) length of the rainy season, which is prerequisite for planning of cropping system. In addition to this it is also desirable to have information on the periods during which dry weather conditions are likely to prevail so that advance action can be taken up to avoid severe moisture stress to the crop.

Victor *et al.*(1991) analysed the weekly rainfall data of 21 district of Andhra Pradesh for contingency crop planning. Pandarinath (1991) used the Markov chain model to study the probability of dry and wet spell in terms of the shortest period like week . A number of research worker have demonstrated its practical utility in crop planning. In this paper an attempt has been made to determine the onset, withdrawal, length of rainy season and its variability and dry spell periods in Udaipur region.

MATERIAL AND METHODS

Daily rainfall data of 20 years (1981-2000) were collected from the College of Technology & Engineering, Udaipur for analysis. Start of rainy season was computed from weekly rainfall data following Morris and Zandstra (1979). In this method weekly rainfall was summed by forward accumulation (22+23+----+52 weeks) until a certain amount of rainfall is accumulated. If this process is repeated for a long period, then the probability of given amounts of rain can be determined for each week. An

amount of 75 mm accumulated rainfall, at the onset time of the given season was selected as it is considered sufficient for land preparation and sowing of dry seeded crops .

The end of the rainy season was determined by backward accumulation of rainfall (52+51+ ----+41 weeks) data. Accumulation of 10 mm rainfall was chosen to identify end of rainy season. Then the years were assigned with rank numbers *i.e* 1981 to 2000 as 1 to 20. The probability (P) of each rank was calculated by the following Weibull's formula:

$$P = M / (N+1) \times 100 \quad \text{---i}$$

where, M is the rank number and N is number of years.

The probability of occurrence of two consecutive dry weeks was computed by Markov-Chain process (Robertson, 1976). Pandarinath (1991) considered less than 20 mm rainfall are dry week. The general formula for dry spell of weeks (n consecutive weeks) is given by :

$$P(D,D,D,\text{----------},n) = P(D) \times P(D/D)^{n-1} \quad \text{---ii}$$

The probability of consecutive dry weeks is calculated as follows

$$P(2D) = P(D) \times P(D/D)_2 \quad \text{--- iii}$$

where

P(2D) = Probability of occurrence of two consecutive dry weeks,

P(D) = Probability of the week being dry

$P(D/D)_2$ = Probability of 2nd consecutive dry week given the preceding week being dry .

RESULTS AND DISCUSSION

Weekly rainfall

The data of mean weekly rainfall and their co-efficient of variation (c.v.) for each standard meteorological week is given Fig.1. Rainfall of more than 20 mm was recorded in 13 weeks (Fig. 1) from 25th-36th weeks and 38th week while, more than 40 mm rainfall was recorded only in 4 weeks from 29th to 30th, 32nd and 34th weeks . The maximum mean weekly rainfall (58.4 mm) was recorded in the 30th week with 98 per cent c.v. while, mean weekly rainfall of zero value was recorded in 13th, 48th and 49th weeks. The least c.v. (76.5 per cent) was recorded in 29th week.

Characteristics of rainy season

Start, end and length of the rainy season and its variability in Udaipur region are presented in Table 1. The rainfall is received from south-west monsoon (June-September) and post monsoon season (October - November) in the region. Before the start of the south-west monsoon season some rainfall may be expected due to pre-monsoon thunder showers. Considerable variation in the start and end of rainy season occur form year to year. From the 20 years data the earliest start of the rainy season had occur during 24th week (11-17 June) and the delay in start was as late as 30th week (23-29 July). the normal start falling in the 27th week (2-8 July).

The per cent probability of start of the

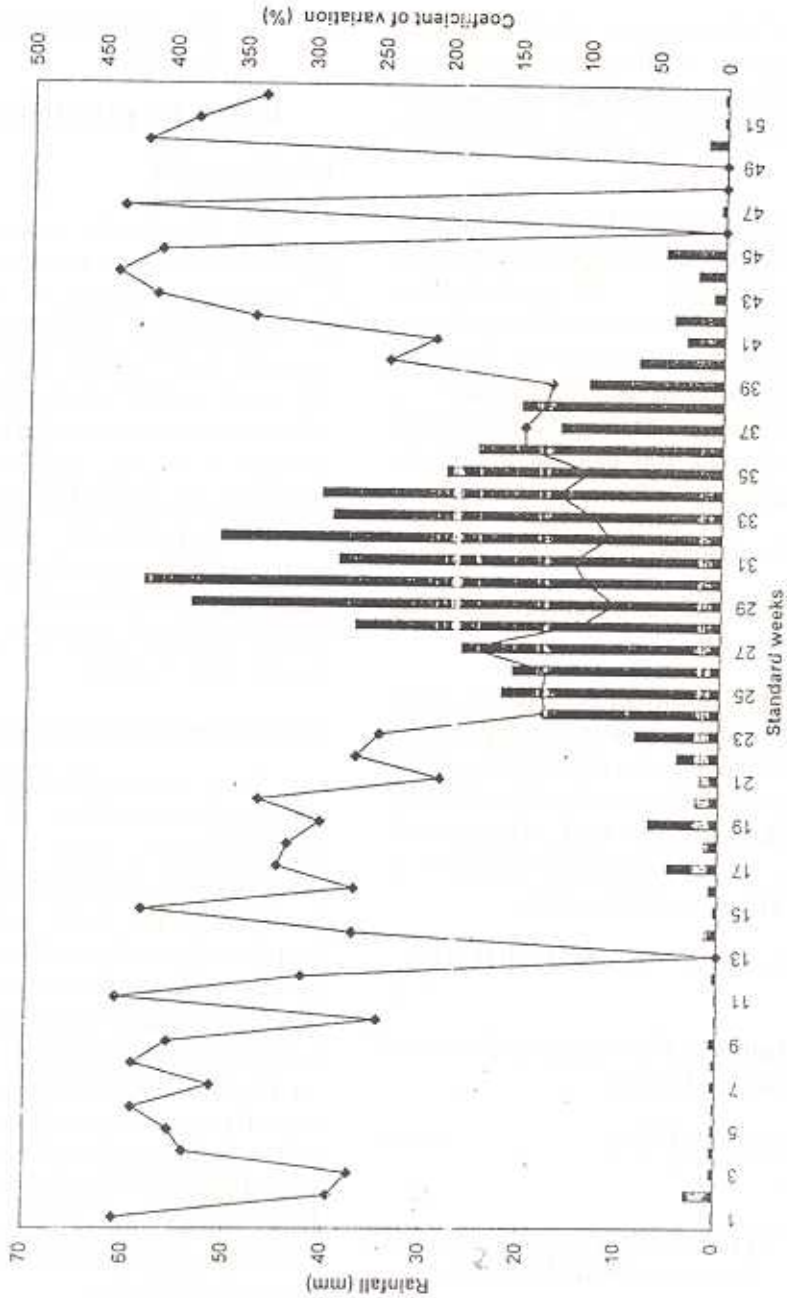

Fig. 1 : Weekly variation of rainfall at Udaipur

Table 1 : Characteristics of rainy season in Udaipur region

Start of rainy season (week number)			End of rainy season (week number)			Length of rainy season (weeks)			
Early	Late	Mean	Early	Late	Mean	Max	Min	Mean	C.V.
24	30	27	36	50	41	24	8	14	26

Table 2: Probability of the start of rainy season in Udaipur region

Weeks	24	25	26	27	28	29	30
Probability (%)	10	24	48	62	81	91	95

Table 3: Probabilities (%) for the end of rainy season in Udaipur region

Weeks	36	37	38	39	40	41	42	43	44
Probability (%)	95	91	86	76	52	38	29	-	14

Table 4: Probability of occurrence of two consecutive dry weeks with rainfall less than 20 mm in Udaipur region

Probability levels (%)	<10	10-25	25-50	>50
Dry weeks	28-29, 31-32	27,30	25-26 ,34	35 onwards

rainy season during different standard meteorological weeks are presented in Table 2. Start of the rainy season may be expected by 28th week with a probability of 81 per cent i.e. the rainy season can be expected to start on an average in 4 out of 5 years.

Data revealed that the earliest withdrawal of south-west monsoon in the region was 36th week (Table 3) with 95 per cent probability . The normal cessation of rainy season was by 40th week with a probability of 52 per cent. The length of the rainy season ranges from 8-24 weeks and with mean of 14 weeks and c.v. of 26 per cent .

Occurrence of two consecutive dry weeks

Dry spells due to inadequate rainfall may occur throughout the rainy season. The weekly evaporative demand of the region varies from 40 mm during the beginning of the rainy season to 30 mm during active rainy season. A week receiving rainfall about 20 mm will be able to meet 0.5 to 0.75 times the evaporative demand. During the early stages of crop growth, the crop water requirement will be about half of the

evaporative demand and subsequently increases during the reproductive stages of crop growth. Therefore, a week with rainfall less than 20 mm was considered as dry week (Pandarinath, 1991). However, during dry week, the crops may meet its water requirements through the moisture available in the soil. If the rainfall is less than 20 mm per week for two or more consecutive weeks the crops are likely to be subjected to moisture stress due to lack of adequate stored soil moisture. The standard meteorological weeks during which dry spell of two consecutive weeks are likely to commences with probability less than 10, 10-25, 25-50 and greater than 50 % is given (Table 4).

It would be seen that in the region, mid season drought is likely during the period 31, 32-33 weeks and 34th week with probability of less than 10, 10-25 and 25-50 per cent, respectively due to the break in monsoon condition. Terminal droughts are likely to occur by the 35th week.

In rainy season, off-season tillage and some other tillage practices can be initiated from 24th week in the region. Sowing of crops may be started from 27th week (2-8 July). The major crops of the region are maize, sorghum, pulses, groundnut and sesame. In the event of delayed start of the rainy season, traditional crops may have to be replaced by alternate crops / varieties such as maize of short duration (Navjot) or growing of pulses and sesame. In the event of mid season drought, mulching will help in reducing soil evaporation and conservation of moisture in top layers of the soil. In the event of terminal drought (35th week) the crop requires supplementary irrigation which may be given by from harvested rain water and its recycling.

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